The Influence of the New Pathway Curriculum on Harvard Medical Students

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Background. This study evaluated the effect of a radically redesigned curriculum at Harvard Medical School on preclinical students' knowledge, skills, personal characteristics, approaches to learning, and educational experiences. **Method.** Multiple measures were used to collect data from 121 students from the entering classes of 1989 and 1990 who had been randomly assigned to the New Pathway or traditional curricula; all had applied to be in the new curriculum. **Results.** The New Pathway students reported that they learned in a more reflective manner and memorized less than their control counterparts in the traditional curriculum during the preclinical years. The New Pathway group preferred active learning and demonstrated greater psychosocial knowledge, better relational skills, and more humanistic attitudes. They felt more challenged, had closer relationships with faculty, and were somewhat more anxious than those in the traditional program. There was no difference in problem-solving skills or biomedical knowledge base. **Conclusion.** Students in the new curriculum learned differently, acquired distinctive knowledge, skills, and attitudes, and underwent a more satisfying and challenging preclinical medical school experience without loss of biomedical competence. These findings should encourage other schools to consider such a curriculum. *Acad. Med.* 69(1994):983–989.

In response to recurrent challenges in this century to reform medical education,[1–5] a number of medical schools have replaced traditional educational methods with innovative curricula.[6–10] But no one is certain just how these innovations have influenced educational outcomes.[11] In some cases the reforms have not been evaluated; in others, the evaluations have had limitations. This lack of hard data has led many medical school faculty to question whether radical curriculum change will work or be worth the effort.

The initial design of a new curriculum undertaken at Harvard Medical School provided a unique opportunity to assess its influence on preclinical students. For two years, the New Pathway (NP), as the innovative program was called, ran as a parallel track with the traditional curriculum. Students who requested the NP were randomly assigned to it or to the traditional curriculum by lottery. We were thus able to compare the experiences and educational outcomes of an experimental group that chose the NP with those of a comparable control group that requested the NP but got the traditional program.

FEATURES OF THE TWO CURRICULA

Broadly stated, the three major objectives of the NP curriculum[12] were to ensure that students develop adequate biomedical knowledge bases, to produce humanistic physicians skilled in integrating social and behavioral concepts with biologic principles in patient care, and to have students acquire skills in and positive attitudes toward self-directed learning. The new curriculum sought to achieve these objectives by creating a teaching and learning environment in which students participated actively in and assumed responsibility for their own learning in small faculty-led tutorial groups, where they used clinical problems as the basis for their study.

The curriculum for the NP has been described in detail elsewhere.[13] It differed in many ways from the traditional program, but several features appeared especially likely to influence the educational goals outlined above. These occurred in the preclinical years and were the use of problem-based learning (PBL), intense small-group interaction, and participation in a longitudinal course on the patient–doctor relationship that integrated clinical skill development with ethics, preventive medicine, and the social and behavioral sciences.

While their counterparts in the traditional program learned largely from lectures and syllabi in disciplinary courses, NP students used PBL[14] to learn basic science in a clinical context. In PBL, students analyze a clinical case in small groups, set a learning agenda, and then study independently before returning for further tutorial discussion.

Throughout the course on the patient–doctor relationship, a later version of which is described elsewhere,[15] the students met in tutorials with the following features: a three-year relationship between the same small group of students and faculty; a "mentoring" relationship of teachers with students; interweaving of material from the social and behavioral sciences, ethics, health promotion and disease prevention, and the humanities with teaching about clinical skills; emphasis on self-reflection within the small group; and opportunities to discuss and reflect on experiences that occur in clinical settings from the beginning of school.

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By contrast, the students in the traditional curriculum learned preventive medicine, social sciences, and psychiatry in discipline-based lectures. Traditional students began interviewing patients and learning clinical skills in the last few months of their second year.

HYPOTHESES THAT THIS STUDY TESTED

Educators have hypothesized both potential advantages and risks of PBL.[16-19] We speculated that NP students, when compared with controls in their first two years, would feel more motivated and challenged, be more positively oriented to learning for understanding, and know better how to approach and solve problems. We worried that NP students might acquire less comprehensive factual knowledge than their control peers.

We hypothesized that NP students' experiences in the course on the patient–doctor relationship would give them greater knowledge of the social and behavioral sciences, more humanistic attitudes (patient-centered orientation, comfort with emotions, and tolerance of ambiguity), and superior skills relating to patients (technical interviewing skills as well as personal qualities such as empathy and attention to the patient's perspective).

METHOD

We compared NP and control students from the classes of 1989 and 1990 at points throughout the four years of medical school. This report focuses on data relevant to their experience in the preclinical years, when the new curriculum was most different from the traditional program. We targeted the assessment on student performance and the perceived experience of being a medical student—the two broad areas most likely to be affected by the curriculum. To assess performance, we examined the following dimensions: biomedical and psychosocial knowledge, basic clinical reasoning, psychosocial skills and attitudes, and learning styles and preferences. The experiential variables we evaluated were subjective reactions to the curriculum and learning environment.

Our evaluation consisted of the following types of measures: basic demographic and attitudinal information on the incoming students, questionnaires and surveys, interviews, faculty ratings, National Board of Medical Examiners (NBME) examination results, and simulation exercises to assess psychosocial skills and knowledge. In all, we used over 25 different instruments or measurement approaches, most of which had been developed and validated elsewhere. In several instances, we developed our own instruments to measure attributes that had no ready-made assessment tool. Student participation in the study's procedures was voluntary except for the NBME examinations.

We used two-tailed t-tests to compare NP and control groups. There was no significant difference between the 1989 and 1990 classes, so we combined results whenever both classes undertook the same measure at about the same time in the course of medical school. We estimated the power of the measures reported in this study using Cohen's method.[20] We were interested in differences with a medium effect size, at a significance level of $p < .05$. The power estimates ranged from a low of .31 for items with the lowest student response rates to a high of .80 for measures with high student participation. (Cohen states that the average power for papers published in leading social psychology journals is around .50.)

RESULTS

Student Participation

The Harvard Medical School classes of 1989 and 1990 contained 297 students eligible to be in the new curriculum. Of the 125 who requested the NP, 62 were randomized into the new curriculum and 63 to the traditional program, along with the other students who had not requested the NP. The NP and control groups were not different in patterns of age, gender, minority status, career preference, school experience, grade-point averages (GPA) in college, or Medical College Admission Test (MCAT) scores.

Four students were lost to the study early; two controls switched to an alternative program before school started; one NP student left school and another transferred to the traditional curriculum in the first year. Including them in the study groups did not change the results, so we report on the remaining 121 students, all of whom completed their first two years of medical school and were exposed to the intervention. Participation in the study ranged widely on different measures, from 100% of the students in the NBME Part I examination to a low of 67% of the NP students and 38% of the controls in the clinical skills assessment.

Student Performance

Knowledge. The scores of the NP students and controls differed somewhat on six of the seven subtests of the NBME Part I examination, but the differences were not statistically significant (Table 1). On the behavioral science subtest, the NP students scored significantly higher. There was no difference when we tested the two groups in their fourth year asking them to recall material learned in preventive medicine and biochemistry in years one and two.

Clinical reasoning. We administered a group of diagnostic reasoning and clinical problem-solving tasks prior to each student's third-year medicine clerkship. The 1989 students reasoned through a clinical case presented as an oral examination, recalled relevant laboratory test results from clinical vignettes used in expert–novice studies,[21] and solved a computer-simulated clinical case developed at Southern Illinois University.[22] Finding no difference, we tried another set of instruments at the end of the class of 1990's second year. We administered a computer-simulated clinical case developed at the Massachusetts General Hospital and a clinical pattern recognition test developed by the National Board of Medical Examiners.[23] We found no difference between the groups' performances

Table 1

Mean Scores on the NBME Part I for New Pathway and Control Students, Harvard Medical School, Classes of 1989 and 1990*

	New Pathway ($n = 60$)		Control ($n = 61$)		
NBME I	Mean	(SD)	Mean	(SD)	p
Anatomy	−0.13	(1.00)	0.13	(1.01)	.16
Behavioral science	0.37	(0.94)	−0.09	(1.01)	.01
Biochemistry	−0.04	(1.13)	0.09	(0.94)	.50
Microbiology	0.16	(1.08)	−0.16	(0.99)	.10
Pathology	0.13	(1.02)	0.10	(1.04)	.89
Pharmacology	−0.07	(1.11)	0.01	(1.09)	.71
Physiology	0.06	(1.06)	0.20	(0.88)	.43
TOTAL	0.06	(1.09)	0.07	(1.01)	.96

*All students applying to be in the New Pathway curriculum were randomly assigned to that curriculum or to the traditional curriculum (control group). The table shows mean scores on the National Board of Medical Examiners Part I examination that have been standardized to a mean of 0 and a standard deviation of 1.00 (the medical school does not allow publication of actual scores). Power is estimated at .80.

gardless of the methodology used to measure clinical reasoning at the end of year two.

Psychosocial attitudes and skills. To assess the students in this area, we collected data from the students, blinded observers, and standardized patients. Twenty measures were analyzed across six global dimensions: empathy, patient-centered orientation, comfort with emotions, tolerance of ambiguity, communication skills, and data collection.

To measure students' attitudes about humanism and social issues in medicine, we used two self-report instruments at the beginning, middle, and end of the preclinical years: a survey of attitudes toward social issues in medicine (ATSIM)[24] and a Q-sort self-report instrument.[25] At the start of school, there was no difference on any of the scales from either instrument. By the end of year two (Table 2), the NP students expressed significantly greater appreciation of the importance of the doctor–patient relationship but not of prevention or social factors in health. The Q-sort showed that humanistic attitudes progressively diverged, so that the NP students, at the end of the second year, were much more likely than the controls to view themselves as empathic toward the patient's experience and tolerant of ambiguity. On seven of seven measures of humanistic attitudes, the NP students scored higher than the controls; three were statistically significant.

The students' responses to a test measuring their views about the characteristics of the ideal physician confirmed these differences. The students in the NP valued physicians who displayed characteristics of humility, self-doubt, self-awareness, and recognition of personal limits significantly more highly than did the controls. No difference between groups had been apparent at the start of medical school.

To assess the students' interpersonal skills, we videotaped them interviewing standardized patients[26] at the end of year two and blindly analyzed these interviews using three different scoring methods from the literature[26–28] and one that we developed. The latter, called the NP interview-rating form (NPIRF), used Likert rating scales to measure five dimensions: communication skills, empathy, use of self as a therapeutic instrument, attention to the patient's perspective, and patient education (Cronbach's alphas of .70, .85, .88, .90, and .84, respectively).

Across all measures rated by observers, the new curriculum was more effective than the traditional curriculum in teaching interpersonal skills during the first two years. Observer ratings of interpersonal skills of the NP students were higher than the ratings of the controls on 12 of 13 measures, with seven significant at $p < .05$. The NP students gathered more total information from the standardized-patient interviews at the end of year two, largely because they elicited significantly more health-behavior information than did the controls.

Only 68% of the NP and 38% of the control students took part in the standardized-patient assessment, with further reductions in some individual measures because of missing data. To determine whether this self-selection caused bias, we used analysis of variance (ANOVA) to compare participating and nonparticipating students on GPAs, MCAT scores, social-medicine attitudes (ATSIM), and NBME scores. We found no differences except one: there was a significant ($p = .04$) interaction effect between curriculum and participation for the behavioral medicine subtest of the NBME Part I (the participating NP students scored significantly higher and the participating controls significantly lower than their respective nonparticipants).

Learning styles and preferences. We repeatedly tested the students about their learning style preferences using the Preferred Learning Style Index (PLSI)[29] (Table 3). At the start of school, the NP students already manifested a significant preference for discovery-style, or student-directed, learning, while the controls preferred learning in a traditional fashion—more receptive, or teacher-directed, learning.

The gap between the relative learning preferences on the PLSI widened further in year two. Even after adjusting with analysis of covariance (ANCOVA) for the differences in PLSI scores at matriculation, the NP and control differences remained significant at $p < .001$.

These results were supported by the Cognitive Behavior Survey,[30] an instrument that Mitchell developed to provide more detail on student learn-

Table 2

Mean Scores for Psychosocial Skills that Attitudes of New Pathway and Control Students at the End of Their Second Year, Harvard Medical School, Classes of 1989 and 1990*

	New Pathway			Control			
Subscale†	Mean Score	No. of Students	(SD)	Mean Score	No. of Students	(SD)	*p*
Self-rated humanistic attitudes							
Doctor–patient relationship orientation[24]	7.85	55	1.11	7.35	54	1.08	.02
Preventive orientation[24]	18.74	54	2.68	18.46	54	2.40	.57
Social medicine orientation[24]	17.87	54	3.11	17.67	54	2.58	.71
Empathy[28]	22.56	24	8.15	17.07	14	6.13	.04
Tolerance of ambiguity[25]	54.45	38	9.06	48.53	15	10.09	.04
Comfort with emotion[25]	56.61	38	12.01	51.87	15	10.18	.18
Patient-centeredness[25]	68.21	38	19.12	60.93	15	14.29	.19
Observer-rated interpersonal skills							
% biomedical information[26]	76.71	41	14.07	77.71	23	12.75	.78
% psychosocial information[26]	68.32	41	26.76	58.91	23	24.99	.17
% health behavior information[26]	61.38	41	33.21	39.71	23	32.88	.02
% total information gathered[26]	68.81	41	18.12	58.78	23	15.33	.03
Communication skill*	50.79	33	10.19	40.00	13	13.99	.01
Patient education*	8.08	40	2.36	6.26	19	2.96	.01
Empathy*	6.45	40	2.62	4.85	20	3.23	.04
Attention to the patient's perspective*	22.68	40	6.71	19.15	20	8.12	.08
Therapeutic use of self*	25.53	40	5.05	22.85	20	7.55	.11
Affective content[27]	1.29	35	1.35	0.46	16	0.46	.02
Standardized-patient–rated interactional skills							
Arizona Clinical Interview Rating Scale[26]	77.77	41	10.72	72.18	23	11.17	.05
Patient satisfaction[26]	3.67	31	0.60	3.33	21	0.67	.06
Empathy[28]	21.82	22	8.95	19.91	16	10.74	.55

*All students applying to be in the New Pathway curriculum were randomly assigned to that curriculum (60 students) or to the traditional cur-riculum (control group of 61 students). For the assessment of psychosocial skills and attitudes shown in the table, the authors used a sign test to determine the likelihood that the New Pathway students would score higher than the controls on 19 of 20 items by chance, finding $p < 001$. Estimates for the power of the measures varied from a low of .31 for the lowest response set to a high of .73 for the highest. Half of the items fell between .41 and .46.

†A superscript number following a subscale is a citation to literature listed in the references at the end of this article; an asterisk indicates the subscale is from a measure developed by the authors, the New Pathway interview-rating form.

ing in the preclinical years. This self-report questionnaire uses 115 Likert-scale, open-ended, fill-in, and rank-order items to examine learning behavior, the nature of the learning experience, and epistemological beliefs. Survey questions were developed from student and faculty interviews about learning behavior, observations of students in different learning settings, and review of theoretical and experimental studies.[31–38] Results are summarized in three scales that measure the roles of memorization, conceptualization, and reflection in student learning (Cronbach's alphas for reliability of the scales were .82, .79, and .76, respectively).

The survey was distributed to students in the last semester of their second year. The NP group scored higher than the controls on the scale measuring use of reflection ($t = 4.04$, $p < .001$, $n = 68$) and lower on the scale measuring use of memorization ($t = -2.54$, $p = .01$, $n = 68$). In response to two specific items, the NP students also reported less cramming during the final weeks of a course ($t = -4.93$, $p < .001$, $n = 69$) and a higher proportion of material remembered three months after completion of a course ($t = 1.62$, $p = .10$, $n = 69$).

Student experiences. We assessed the personal experiences and reactions of students to the two preclinical curricula with surveys and interviews. On the Learning Environment Survey[39] given at the start of school, the NP students scored significantly higher than the controls in their re-ported preferences for faculty support and educational innovation and sig-nificantly lower in their need for clar-ity (Table 3). At the end of the second year, the NP students saw themselves as having significantly greater auton-omy, more innovation and involve-ment, and less clarity about their work than the controls. Work pres-sure, experienced as significant-ly higher by the NP students at the end of year one (not shown in the table), was perceived as equally high by both groups after year two.

Qualitative data from semistruc-tured interviews at the end of the seond year indicated that the NP students felt more responsible for their own educational experiences. They were also more anxious and frustrated than their control colleagues, particularly over intratutorial conflicts and what and how much to study. This finding was confirmed in questionnaires administered near graduation that asked students retrospectively to choose key words that described their preclinical curricula. "Stressful, engaging, and difficult" were descriptors cited statistically more frequently (using the chi-square statistic, $p < .05$, $n = 52$) by the NP students as opposed to "nonrelevant, passive, and boring" by the controls. The same instrument showed that the NP students were more than three times as likely as the controls to cite a close relationship with faculty members during their preclinical years.

DISCUSSION

The students in Harvard's new curriculum underwent a markedly different preclinical educational experience than their matched classmates in the traditional program. They viewed this experience as relevant and stimulating but also stressful. They reportedly worked harder, were more involved and less bored, and had greater contact with faculty than their control-group peers in the traditional curriculum. This experience, and especially their perceptions of it, describes an educational process more likely, in our view, to push students to their full potential than the traditional lecture-based curriculum.

The most feared outcome of the NP experiment—that a self-directed curriculum might fail to produce biomedically knowledgeable students—did not materialize. Neither were we able to demonstrate an often-cited goal of PBL—that PBL-curricula students solve problems better. If such differences occur, their demonstration may require larger studies, longer and more complete follow-up, or more sensitive measures of problem-solving competence.

The NP students did manifest consistently better performances in psy-

Table 3

Mean Scores for Preferred Learning Styles and Environments of New Pathway and Control Students at the Start of School and End of Second Year, Harvard Medical School, Classes of 1989 and 1990*

	Start of School								End of School Year							
	New Pathway			Control					New Pathway			Control				
Subscale†	Mean Score	No. of Students	(SD)	Mean Score	No. of Students	(SD)	t	p	Mean Score	No. of Students	(SD)	Mean Score	No. of Students	(SD)	t	p
Learning style[29]																
Discovery	31.64	61	(2.88)	29.45	58	(3.43)	3.78	.00	31.37	54	(3.75)	27.22	54	(4.06)	5.51	.00
Receptive	17.25	60	(2.18)	18.56	59	(2.15)	−3.30	.00	16.64	55	(2.51)	17.98	54	(2.64)	−2.73	.01
Learning environment[39]																
Involvement	8.47	36	(0.74)	8.04	26	(1.25)	1.58	.12	7.61	28	(1.73)	6.48	25	(1.90)	2.26	.03
Peer cohesion	7.53	36	(1.44)	7.58	26	(1.53)	−0.13	.90	7.43	28	(1.50)	7.24	25	(1.54)	0.45	.65
Faculty support	6.92	36	(1.23)	6.15	26	(1.52)	2.19	.03	6.54	28	(1.62)	6.04	25	(1.81)	1.05	.30
Autonomy	7.19	36	(1.06)	6.89	26	(1.24)	1.05	.30	6.61	28	(1.45)	5.68	25	(1.60)	2.21	.03
Task orientation	7.28	36	(1.21)	7.39	26	(1.24)	−0.34	.74	5.07	28	(2.28)	5.76	25	(1.51)	−1.31	.20
Work pressure	6.47	36	(1.50)	6.15	26	(1.74)	0.77	.44	5.68	28	(2.00)	5.68	25	(1.73)	0.00	1.00
Clarity	5.31	36	(1.60)	6.04	26	(1.18)	−1.98	.05	3.46	28	(1.99)	5.00	25	(1.56)	−3.10	.00
Control	3.33	36	(1.62)	3.42	26	(1.65)	−0.21	.08	2.96	26	(1.43)	2.76	25	(1.42)	0.50	.62
Innovation	6.89	36	(1.24)	5.96	26	(1.54)	2.63	.01	7.71	28	(1.49)	3.60	25	(2.52)	7.14	.00

*All students applying to be in the New Pathway curriculum were randomly assigned to that curriculum or the traditional curriculum (control group). Data on students' preferences about learning environment were collected only from the class of 1990.

†The superscript numbers printed after the subscales are citations to literature listed in the references at the end of this article.

chosocial knowledge, skills, and attitudes in the preclinical years. Much criticism has been directed at medical education's damaging effects on the doctor–patient relationship. Our results suggest that the educational environment can have a positive influence on students' early attitudes and performances in this area. It will be important to determine whether gains such as these plateau in the clinical years.

Since the NP- and control-group preferences for learning environment already differed at the beginning of school, we worried that randomization had failed to generate comparable groups. However, these differences continued to widen over time, and both groups initially were significantly more positively oriented toward an active-learning environment than were students who had asked for the traditional curriculum (traditional = 8.78, control = 10.94, NP = 14.41; ANOVA, $F = 31.94$, $p = <.05$, $n = 253$). This suggested a more likely explanation—that students, in an effort to reduce cognitive dissonance,[40] adapt their learning preferences quickly to reflect the style of the curriculum to which they are assigned.

The self-directed curriculum generated anxiety about what and how much to study and created some uncomfortable small-group dynamics. These experiences are similar to challenges that successful clinicians must overcome during their professional socialization. Uncomfortable though these experiences may be, students exposed to them during medical school may arguably be better prepared for life-long learning and the strains of teamwork. Nevertheless, schools might anticipate and help students through this difficulty.

As with any curriculum evaluation, methodologic pitfalls confronted our study. First, the exact nature of the intervention in any major curriculum change is complex and may include unplanned noncurricular effects such as being groundbreakers and receiving greater attention. Second, we faced problems that could have introduced bias into our measurement; among the most important of these were self-selection bias and variable student participation in the evaluation measures. Third, a number of factors reduced the likelihood that students exposed to the two curricula would show significant differences; these included the relatively small samples, the uniformly high academic excellence of the students, the high overlap of overall educational goals of the two curricula, and the comparable experiences and socializing influences in the clinical years. Finally, we had limited choices of validated instruments to measure educational processes and outcomes. We were able to address some but not all of these problems in our study design.

We reduced selection bias by randomly assigning interested students to experimental and control groups. Our data from all students confirmed the importance of minimizing self-selection bias. The NP applicants (including the control-group students as well as those assigned to the NP) had higher premedical grade-point averages and aptitude test scores than those who did not apply. And differences between the NP students and those students who, from the outset, chose to remain in the traditional program were almost always substantially more dramatic than the differences between the NP students and the controls. Based on our data, randomized controlled trials (RCTs) are essential in evaluating curriculum effects, but they are rarely done. Although designed as an RCT, this study failed to meet strict standards[41] on some measures because of low student participation. Despite this methodologic vulnerability, the study reduces selection bias more than any other curriculum evaluation that we were able to find in the literature.

Because we were unable to require participation, low student participation proved a problem for some of our measures, particularly those of psychosocial performance. If low-performing control and high-performing NP students had taken part, this might have produced differences favoring the NP. There was some suggestion, based on the behavioral science subtest of the NBME Part I examination (but not other measures) that this occurred. We cannot exclude the possibility that biased participation contributed to the demonstrated difference in psychosocial skills.

We attempted to reduce the effect of weak instruments by employing multiple outcome measures and methods of data collection. In general, our major conclusions are bolstered by the convergence of findings from more than one type of measure at more than one time.

Finally, we note that we did not formally or systematically assess the opinions of our faculty about the new curriculum, although faculty members can be valuable judges of the results of educational innovations. In the years since the NP began, the Harvard curriculum has progressively shifted to a more student-directed, problem-based format. A number of course leaders and department chairmen, though by no means all, have changed from skeptics to enthusiastic supporters. Our faculty's reaction to this innovation provides indirect support for some of the positive outcomes demonstrated in this study.

Putting these evaluation findings together, we believe the NP curriculum led to a positive, but instructively stressful, educational experience; did no demonstrable harm; possibly enhanced humanism in the first two years; and fostered students' development of self-directed learning skills. The experience of the NP program at Harvard should encourage trials of similar methods at other schools.

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